TCC
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T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	Cph_SAR_0546_03	**Date of report:**	2005-11-16
Template version:	3	**Number of pages:**	15
Testing laboratory:	TCC Copenhagen Nokia Danmark A/S Frederikskaj DK-1790 Copenhagen V Denmark Tel. +45 33 29 29 29 Fax. +45 33 29 20 01	**Client:**	Nokia Danmark A/S Frederikskaj DK-1790 Copenhagen V Denmark Tel. +45 33 29 29 29 Fax. +45 33 29 20 01
Responsible test engineer:	Leif Funch Klysner	**Product contact person:**	Ernest Mayer
Measurements made by:	Jesper Nielsen / Leif Klysner		
Tested device:	RM-79		
Supplement reports:	-		

Testing has been carried out in accordance with:

ANSI/IEEE Std C95.1, 1999 Edition
IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

IEEE 1528 - 2003
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at TCC Nokia.

Test results: **The tested device complies with the requirements in respect of all parameters subject to the test.** The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures: **2005-11-17**

For the contents:

Leif Funch Klysner
Test System Manager

Digitally signed by Leif Funch Klysner
DN: cn=Leif Funch Klysner, c=DK, o=Radio Spectrum, ou=CertT, email=leif.klysner@nokia.com
Reason: I am approving this document
Date: 2005.11.17 12:15:05 +01'00'

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2005-11-10 to 2005-11-11
SN, HW and SW numbers of tested device	IMEI: 004400/72/174317/5 HW: 0510 SW:03.09 DUT#28462
Batteries used in testing	BP-6M, DUT#28464, 28465, 28465, 28466, 28467
Other accessories used in testing	SD card, DUT#28460
State of sample	Prototype unit
Notes	

1.2 Maximum Results

The maximum SAR value, when measured at the ear, is given in the table below. The device conforms to the requirements of the standard when the maximum measured SAR value is less than or equal to the limit.

Mode	Ch / *f* (MHz)	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
2-Slot GPRS1800	699/1747.6	Right, Tilt	1.6 W/kg	0.87 W/kg	PASSED

1.2.1 Maximum Drift

Maximum drift during measurements	-0.17 dB

1.2.2 Measurement Uncertainty

Expanded Uncertainty (k=2) 95%	± 29.8 %

2. DESCRIPTION OF THE DEVICE UNDER TEST

Exposure environment	General population / uncontrolled

Modes and Bands of Operation	GSM 1800	GPRS 1800	EGPRS 1800	BT
Modulation Mode	GMSK	GMSK	8PSK	GFSK
Duty Cycle	1/8	1/8 or 2/8	1/8 or 2/8	
Transmitter Frequency Range (MHz)	1710 - 1785	1710 - 1785	1710 - 1785	2402 – 2480

Apart from the bands quoted in the table above, the transmitter of tested device is capable of operating also in GSM850, GSM1900 and WCDMA1900, which are not part of this filing.

SAR measurements in 2-slot GPRS mode against the head profile of the phantom give conservative SAR results.

2.1 Picture of the Device

Front - closed

Front - open

Side

Rear

3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature (°C):	20.5 to 22.5
Ambient humidity (RH %):	35 to 55

3.2 Test Signal, Frequencies and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.

The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.

In all operating bands the measurements were performed on lowest, middle and highest channels.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement System and Components

The measurements were performed using an automated near-field scanning system, DASY4 software version 4.6, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements on the device was the 'worst-case extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DAE 3	501	12 months	2006-01
E-field Probe ET3DV6	1807	12 months	2006-01
Dipole Validation Kit, D1800V2	230	24 months	2006-01

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	SMIQ03B	826046/034	36 months	2007-02
Amplifier	ZHL-42W	E012903	-	-
Power Meter	NRVD	833696/030	24 months	2006-05
Power Sensor	NRV-Z51	843275/004	24 months	2007-02
Call Tester	4400M	0411216	-	-
Vector Network Analyzer	AT8753ES	MY40001091	12 months	2006-08
Dielectric Probe Kit	HP85070B	US33020403	-	-

4.2 Phantoms

The phantom used for all tests i.e. for both system checking and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2003.

System checking was performed using the flat section of the phantom between the head profiles, whilst Head SAR tests used the left and right head profile sections.

The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 - 2003. All tests were carried out using simulants whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the tissue simulant was 15.0 ± 0.5 cm measured from the ear reference point during system checking and device measurements.

4.3.1 Tissue Simulant Recipes

The following recipes were used for head tissue simulants:

1800 MHz band

Ingredient	% by weight
Deionised Water	54.88
Butyl Diglycol	44.91
Salt	0.21

4.3.2 System Checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system checking results (dielectric parameters and SAR values) are given in the table below.

System checking, head tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters ε_r	Dielectric Parameters σ [S/m]	Temp [°C]
1800	Reference result	10.0	39.0	1.38	
	± 10% window	9.0 to 11.0			
	2005-11-10	9.55	38.2	1.37	21.1
	2005-11-11	9.75	38.1	1.38	21.5

4.3.3 Tissue simulants used in the measurements

Head tissue simulant measurements

f [MHz]	Description	Dielectric Parameters ε_r	Dielectric Parameters σ [S/m]	Temp [°C]
1748	Recommended value	40.1	1.37	
	± 5% window	38.1 – 42.1	1.30 – 1.44	
	2005-11-10	38.4	1.32	21.1
	2005-11-11	38.3	1.32	21.5

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

A Nokia designed spacer (illustrated below) was used to position the device within the SPEAG holder. The spacer positions the device so that the holder has minimal effect on the test results but still holds the device securely. The spacer was removed before the tests.

Nokia spacer

5.2 Test Positions

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to IEEE 1528 - 2003 " IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”.

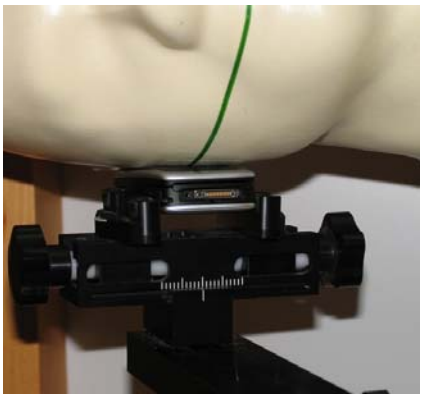


Photo of the device with the slide closed in “cheek” position

Photo of the device with the slide closed in “tilt” position

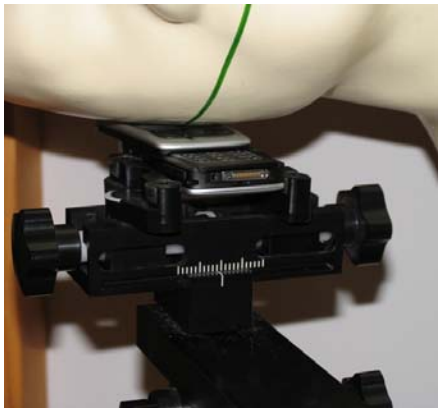


Photo of the device with the slide open in “cheek” position

Photo of the device with the slide open in “tilt” position

5.3 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan, a minimum of 5x5x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy4 are all based on the modified Quadratic Shepard's method (Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

6. MEASUREMENT UNCERTAINTY

Table 6.1 – Measurement uncertainty evaluation

Uncertainty Component	Section in IEEE 1528	Tol. (%)	Prob Dist	Div	c_i	$c_i . u_i$ (%)	v_i
Measurement System							
Probe Calibration	E2.1	±5.8	N	1	1	±5.8	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1-c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±8.3	R	√3	1	±4.8	∞
Linearity	E2.4	±4.7	R	√3	1	±2.7	∞
System Detection Limits	E2.5	±1.0	R	√3	1	±0.6	∞
Readout Electronics	E2.6	±1.0	N	1	1	±1.0	∞
Response Time	E2.7	±0.8	R	√3	1	±0.5	∞
Integration Time	E2.8	±2.6	R	√3	1	±1.5	∞
RF Ambient Conditions - Noise	E6.1	±3.0	R	√3	1	±1.7	∞
RF Ambient Conditions - Reflections	E6.1	±3.0	R	√3	1	±1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	±0.4	R	√3	1	±0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	±2.9	R	√3	1	±1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	±3.9	R	√3	1	±2.3	∞
Test sample Related							
Test Sample Positioning	E4.2.1	±6.0	N	1	1	±6.0	11
Device Holder Uncertainty	E4.1.1	±5.0	N	1	1	±5.0	7
Output Power Variation - SAR drift measurement	6.6.3	±10.0	R	√3	1	±5.8	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	±4.0	R	√3	1	±2.3	∞
Conductivity Target - tolerance	E3.2	±5.0	R	√3	0.64	±1.8	∞
Conductivity - measurement uncertainty	E3.3	±5.5	N	1	0.64	±3.5	5
Permittivity Target - tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			**±14.9**	206
Coverage Factor for 95%			**k=2**				
Expanded Standard Uncertainty						**±29.8**	

7. RESULTS

The measured SAR values for the test device are tabulated below:

1800 MHz SAR results

Mode	Option	Test configuration		SAR, averaged over 1g (W/kg)		
				Ch 512 1710.2 MHz	Ch 699 1747.6 MHz	Ch 885 1784.8 MHz
2-Slot GPRS1800	Slide closed	Left	Cheek	-	0.435	-
			Tilt	-	0.632	-
		Right	Cheek	-	0.765	-
			Tilt	0.686	**0.847**	0.802
2-Slot GPRS1800	Slide open	Left	Cheek	-	0.226	-
			Tilt	-	0.181	-
		Right	Cheek	-	0.328	-
			Tilt	-	0.259	-
GSM1800	Slide closed	Left	Cheek	-	0.270	-
			Tilt	-	-	-
		Right	Cheek	-	-	-
			Tilt	-	-	-
2-Slot GPRS1800	Slide closed	Highest SAR value measurement in this band repeated with SD card		-	**0.869**	-
2-Slot GPRS1800	Slide closed	Highest SAR value measurement in this band repeated with BT active		-	0.849	-

Plot(s) of the maximum Measurement scan(s) is/are given in Appendix A.

APPENDIX A: MEASUREMENT SCAN(S)

See the following pages.

Date/Time: 2005-11-10 21:47:37

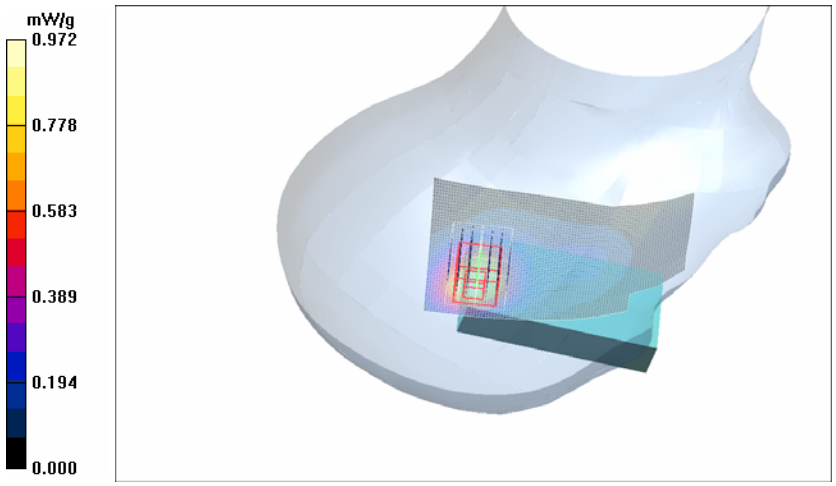
Test Laboratory: TCC Copenhagen
Type: RM-79; Serial: 004400/72/174317/5

Communication System: 2-slot GPRS1800
Frequency: 1747.6 MHz; Duty Cycle: 1:4.2
Medium: Head 1800; Medium Notes: Medium Temperature: t=21.1 C
Medium parameters used: f = 1748 MHz; σ = 1.32 mho/m; εr = 38.4; ρ = 1000 kg/m3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1807; Probe Notes: Worst Case Extrapolation
- ConvF(5.19, 5.19, 5.19); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn501; Calibrated: 2005-01-24
- Phantom: SAM Low band; Type: Twin Phantom; Serial: TP-1037
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 160

Tilt position - Middle - Slide closed/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.972 mW/g

Tilt position - Middle - Slide closed/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 22.8 V/m; Power Drift = -0.055 dB
Peak SAR (extrapolated) = 1.62 W/kg
SAR(1 g) = 0.847 mW/g; SAR(10 g) = 0.479 mW/g
Maximum value of SAR (measured) = 0.910 mW/g



Date/Time: 2005-11-11 18:48:34

Test Laboratory: TCC Copenhagen
Type: RM-79; Serial: 004400/72/174317/5

Communication System: 2-slot GPRS1800
Frequency: 1747.6 MHz; Duty Cycle: 1:4.2
Medium: Head 1800; Medium Notes: Medium Temperature: t=21.5 C
Medium parameters used: f = 1748 MHz; σ = 1.33 mho/m; εr = 38.3; ρ = 1000 kg/m3
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1807; Probe Notes: Worst Case Extrapolation
- ConvF(5.19, 5.19, 5.19); Calibrated: 2005-01-21
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn501; Calibrated: 2005-01-24
- Phantom: SAM Low band; Type: Twin Phantom; Serial: TP-1037
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

Tilt position - Mid - Slide closed - SD card/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.956 mW/g

Tilt position - Mid - Slide closed - SD card/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.0 V/m; Power Drift = -0.167 dB
Peak SAR (extrapolated) = 1.78 W/kg
SAR(1 g) = 0.869 mW/g; SAR(10 g) = 0.494 mW/g
Maximum value of SAR (measured) = 0.927 mW/g